ALBERTA RESEARCH COUNCIL

Annual Report 1989

MISSION STATEMENT

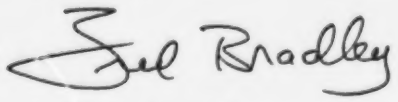
The mission of the Alberta Research Council is to advance the economy of the province by promoting technology development, performing applied research, and providing expert advice, technical information and scientific infrastructure that is responsive to the needs of the private sector and supports activities in the public sector.

Letter of Transmittal

To The Honorable Fred A. Stewart
Minister of Technology, Research & Telecommunications

In accordance with the requirements of the Alberta Research Council Act, I have the honor to present to you the Annual Report of the Alberta Research Council for the calendar year 1989.

Respectfully submitted,



Fred D. Bradley, M.L.A.
Chairman of the Board
Alberta Research Council

February 1990

Corporate Profile

The Alberta Research Council is a crown corporation of the Province of Alberta, with 600 employees, offering a diversified range of scientific, engineering and technological research and testing capabilities in:

Advanced Technologies: Computer-based technologies including automation, expert systems and robotics for application and transfer to industry.

Biotechnology: Microbiology; fermentation technology and scale-up; bioprocess engineering; plant cell culture; biosafety; bioscience space research.

Coal and Hydrocarbon Processing: Advanced process research focusing on heavy oil, bitumen, natural gas, and coal resource upgrading and utilization. The work includes coal upgrading, combustion and gasification, natural gas treatment and conversion; key elements are resource characterization and evaluation.

The Electronics Test Centre: Provides testing and evaluation services to electronic and telecommunications products manufacturers requiring product certification, and provides companies with engineering assistance in planning and developing new products.

Forestry: Forest products development and testing of forest products using Alberta forest resources; application of technologies such as land related information systems to the forestry sector.

Geological Survey: Characterization of oil sand, coal, industrial and metallic minerals; hydrocarbon reservoir analysis and characterization; site selection and prediction of effects of deep disposal of liquid wastes; metallic mineral core library and geoscience information systems.

Materials and Testing: Research and development in advanced materials; waste management, recycling and utilization; materials testing; gasoline and oil, and industrial chemicals and products; analytical chemistry.

Oil Sands and Hydrocarbon Recovery: Thermal heavy oil and enhanced recovery investigations; physical and numerical simulations; waxy crude studies; production and pipelining studies; technical and economic evaluation and modelling; maintenance of an oil sand sample bank.

Resource Technologies: Environmental sensing and modelling; spatial information and data acquisition; land-related information systems (LRIS); civil engineering research on transportation and rivers.

Terrain Sciences: Management of soil and groundwater resources; land reclamation for use after surface mining; industrial waste management; contaminant hydrogeology.

Joint Research Venture Program: Sharing resources with participating companies to help these Alberta industries take innovative and marketable technology to commercial development.

Industrial Technology Advisor Network (ITAN): Provides short-term advisory and technical services to Alberta companies; administration of the National Research Council's IRAP programs for Alberta industry.

The Alberta Research Council is a member of the Association of Provincial Research Organizations (APRO).

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Chairman's and President's Message

As we usher in the last decade of this century, Canada will begin to feel the full force of the new global economy. If the Alberta Research Council is to meet the challenges of rapid change, we must step into 1990 and the years that follow with clear-cut strategies.

There are two major issues, in particular, to address in the coming decade. The first is to harmonize the development of our natural resources with full protection of the environment – to provide "sustainable development" as it is now popularly expressed. The second is to enhance the linkages between our resource industries and our high technology capabilities to mutual advantage.

The Alberta Research Council has organized itself to contribute to these two goals. Our departments, involved with resource technologies and environmental protection, have been brought together as a new Resource Technologies division; our departments working with emerging technologies identified for strategic Canadian

Dr. C.W. Bowman, left, and Fred D. Bradley.

emphasis, have been brought together into a new Advanced Technologies division.

We believe this simplified management structure, shown on page 50, best matches the challenges and opportunities facing Alberta on the horizon of the 21st century.

Earlier this year, the Alberta Research Council published DIRECTIONS, a document which sets out specific program and financial goals for both the corporation and our individual research departments. The key program goals are embodied in four strategies: linking high technologies and resource industries, providing access to national and international technologies, maintaining resource inventory/assessment programs, and using our resources to meet the short- and long-term technology needs of our private and public sector clients. On the financial side, the Research Council is seeking a more appropriate balance in the funding provided by Alberta government and non-Alberta government sources, and hopes to achieve a one third/two thirds division by 1992. This funding change reflects a strategy of working more closely with private sector clients and industrial consortia.

We have promised our clients more than just the resources of the Alberta Research Council. By signing some 21 memoranda of understanding with federal and provincial government agencies or laboratories, universities, research and technical institutes, we have access to the full technical expertise of all signatories. Another 15 agreements are in draft form.

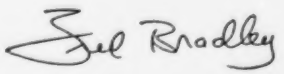
The Alberta Research Council network continues to diversify and expand, including: the co-sponsorship, with the Electronics Network Association of Alberta, of an Ottawa technical office to facilitate access by Alberta firms and organizations to federal government projects; the support of a technology liaison officer working in the Alberta government's office in Tokyo, to help lay the framework for a Pacific Rim strategy; development of collaborative project plans in space with U.S.S.R. scientists; a technical mission to ENI in Italy as a step towards a Europe 1992 strategy; and various scientific investigations carried out around the world, including completion of a project in Indonesia.

New programs are essential to maintaining a research laboratory at the leading edge of technology. The Alberta Research Council has developed or is establishing the framework for new programs in industrial waste management, hydrogen technologies, space technologies, oil sand sludge processing, and advanced materials. The Research Council expects to be a major participant in new industrially related programs as the next decade unfolds. We intend to do this in partnership with the private sector – in bilateral joint projects helping individual companies expand into international markets, and in consortia, solving major sector-wide technology problems.

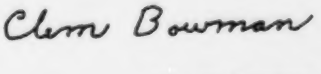
Every employee has a contribution to make in meeting our goals and in shaping the organization. We are committed to supporting and encouraging our employees in the pursuit of their career goals through training and in providing a safe and healthy work environment. Our annual awards program recognizes the achievements and contributions made by individual employees. We applaud this year's award winners whose names are listed on page 43.

We also welcome the Honorable Fred Stewart, Minister, Alberta Technology, Research and Telecommunications, to the Board of Directors and express our appreciation for his counsel and support.

The following sections in this report are examples of the teamwork, and the competence and vigour of our staff. We view their efforts with pride and can look to the future with confidence.



Fred D. Bradley, M.L.A.
Chairman of the Board



Clem W. Bowman
President

Highlights

Advanced Technologies:
A patent application made for Pharm/Hand, a tabletop robot designed and built for the Red Deer Regional Hospital Centre. Advanced Manufacturing Demonstration Facility opened in Calgary.

Biotechnology:
Large-scale plant cell culture yields valuable biochemical. Work in life support systems results in invitation from the Institute of Biophysics, U.S.S.R. Academy of Sciences.

Coal and Hydrocarbon Processing:
Two patent applications filed as a result of heavy oil upgrading research in high-conversion processes and the mechanism of coke formation. This program is funded jointly by AOSTRA and the Alberta Research Council.

Electronics Test Centre:
Test Centre joins with Amtek Testware of Edmonton and EDO of Calgary in successful bid to provide automatic test station for use in maintaining Canadian Forces F-18 fighter aircraft.

Forestry:
Seven patent applications filed, covering innovations in the development or manufacture of composite wood products. First mill evaluation in Canada carried out to new CSA 0325 performance standard for structural panels.

Alberta Geological Survey:
Geologic framework provided for AOSTRA underground test facility expansion. A digital coal database and a demonstration of GIS application to geology prepared.

Materials and Testing:
Advanced materials group is western node of advanced materials network; hosts Canadian Advanced Industrial Materials Forum and Canadian University-Industry Council on Advanced Ceramics conferences.

Oil Sands and Hydrocarbon Recovery:
Patent disclosure made for field application of a novel technology, using foams to improve areal conformance.

Resource Technologies:
Air and water quality research includes development of models to improve monitoring for safe disposal of effluent in Alberta rivers. Climate study on warming trends for Alberta issued.

Terrain Sciences:
Land-related information system pilot project in Morinville area completed for Alberta Planning Board. Five-year soil erosion study completed.

Joint Research Venture Program:
Myrias Research Corporation becomes first Edmonton company to participate in Joint Research Venture program.

ITAN:
Industrial Technology Advisor Network expanded to Red Deer and Lethbridge.

International:
Bitumen evaluations carried out in Indonesia and Cuba. LRIS prototype developed for Bin County, Heilongjiang, China.

Corporate Programs

Each year, Alberta companies have the potential to bring innovative new products, processes and services to the marketplace. To give these industries a helping hand, the Alberta Research Council introduced a technology transfer program through joint research ventures. Now in its sixth year, the Joint Research Venture Program has helped, or is helping, some two dozen companies, many of them in the high technology industry. The accompanying matrix provides an "at a glance" view of where the current activity is taking place. A more detailed description of this year's work is included in the Joint Research Venture Program report (see page 30).

The Industrial Technology Advisor Network, a collaborative program with the National Research Council, is an efficient and cost-effective economic instrument for industrial development and diversification in Alberta. The Alberta Research Council serves as a key facilitator in technology development; the industrial technology advisors provide the bridge between technology sources and potential users (see page 31).

Sector	Agriculture	Energy	High Technology	International	Manufacturing	Minerals
Programs						
Industrial Technology Advisor Network	Remote sensing equipment development Food product development	Equipment development and improvement	New product development and improvement	Access to foreign technology	Industrial engineering services Technology awareness	Application of advanced industrial materials
Joint Research Venture Program	Finely divided sulfur as a fertilizer	Inertial pig for gas pipelines Parallel computing	3-D stereo imaging Airborne microwave landing systems Expert systems		Plant automation	

Department \ Sector	Agriculture	Energy	Environment	Forestry
Advanced Technologies	Expert systems	Geophysical pattern analysis Modelling	Training Spills analysis	
Biotechnology	Herbicide inoculant Biological insecticides Biological fertilizers	Biosurfactants Biomodification of asphaltenes	Bioremediation Manure liquefaction Tailings de-sludging	Lignin degradation
Coal and Hydrocarbon Processing		Heavy oil upgrading Coal oil coprocessing Coal upgrading gasification	Oily waste cleanup Combustion Ash utilization	
Electronics Test Centre				
Forestry	By-products use		Waste materials recycling Wildlife ecological studies	Forest management and site classification Forest land use
Alberta Geological Survey		Oil sands geology Coal geology Petroleum geology and basin analysis	Deep waste disposal	Mineral resources assessment for pulp and paper industry
Materials and Testing	Seed coating Sulfur fertilizer Sulfur herbicide	Hydrogen separation Gasoline testing	Waste exchange Polymer recycling Environmental monitoring Containment pond liners	Coating of debarking knives Wood chemistry
Oil Sands and Hydrocarbon Recovery		Oil recovery technology development Economic modelling	Oil sand tailings study Oil field sludges Geochemistry for waste water injection	
Resource Technologies	Climate change Weather radar Hydrology		Effluent dispersion River, air pollution	LRIS GIS
Terrain Sciences	Soil surveys Erosion, groundwater research	Geological modelling for surface mine planning	Land reclamation Waste characterization Land-based treatment and disposal of oily sludge	

High Technology	*International*	*Manufacturing*	*Minerals*	*Transportation*
Robotics Expert systems AI applications Advanced computing		Demonstration facility Automation CAD/CAM CNC/CIM		Expert systems for highway design Scheduling Maintenance
Low-gravity bioreactor design Advanced fermentation technology	U.S. contracts Consulting: China, Zambia Scientific exchanges	Biological insecticide: limited interim manufacture		Heavy oil viscosity reduction for pipelining
Reactor diagnostics, dynamics Process instrumentation control	Joint programs: U.S., Japan, West Germany Contracts: U.S., Indonesia			Slurry pipelining
Electronic systems development and testing	Testing and evaluation for companies outside Canada Acceptance of Alberta products	Product testing and evaluation: electronics, telecommunications, avionics Quality assurance		
GIS Decision support systems	Acceptance of Alberta products Patents	Product development and testing Quality assurance		
Numerical modelling Image analysis Log analysis GIS	Evaluation: oil sands (Cuba, Indonesia), clay (Guyana) Scientific exchanges: China, U.S.A.	Mineral separation equipment testing, process certification	Mineral clay deposits assessment and databases	Aggregate inventory
Ceramic coating	Scientific exchange	Product prototypes Product testing	Clay analysis Extractive metallurgy	
Computer modelling Computer pump controls	Waxy crudes study Oil deposit evaluation Research program development	Filter design improvements	Inorganic geochemistry	Pipeline transport of heavy and waxy crudes
Remote data acquisition Computing Dataloggers and sensors	Weather radar training Radar polarization Pavement projects	Biotechnical control systems		Aviation technology Pavement management River engineering Geotechnical engineering
GIS application Technology transfer	Scientific exchange	Sampling and monitoring equipment design and adaptation		

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Advanced Technologies

The Advanced Technologies Department, Canada's largest applied research group in artificial intelligence and robotics, has been involved during 1989 in more than 40 applied research and contract activities valued at approximately $2 million.

Advanced Technologies staff designed and built Pharm/Hand, a tabletop robot for the Red Deer Regional Hospital Centre, to select, position, inject and agitate required pharmaceutical drugs into intravenous(IV) minibags. A patent application has been made and the robot is undergoing testing before being shipped to the Red Deer Regional Hospital Centre early in 1990.

A contract, jointly developed by the Advanced Technologies Department and International Submarine Engineering of Port Moody, B.C., was awarded to the company by the Canadian Space Agency's STEAR (Strategic Technologies in Automation and Robotics). The project focuses on identifying and developing technology upgrades required for the Special Purpose Dexterous Manipulator (SPDM), a robot system used for cleaning, inspection, repair and assembly tasks on the Space Station.

The department is working with Det norske Veritas on a project for the Canadian Space Program, investigating the use of real-time expert system technology for predicting and verifying detection of hardware problems in space.

A prototype expert system was developed for estimating production times and manufacturing activities in process planning operations at the Northern Telecom Calgary switching plant, and researchers are applying graph theory in planning a grid pattern allocation for Alberta Government Telephone's cellular network.

As a core research project, the Advanced Manufacturing Demonstration Facility was installed to promote automation and related advanced manufacturing technologies within Alberta, with particular emphasis on addressing the needs of small- to medium-size companies. The facility uses a modular approach to automation in manufacturing and includes a machining workcell, an assembly workcell, and a material transport system. The operation of these modules is coordinated by computer to form an integrated manufacturing system and features the following technologies: Computer Assisted Design and Manufacturing (CAD/CAM), Computer Numerically Controlled (CNC) machining, robotics in machine loading and assembly, automated material transport, sensors, and integrated computer control.

In another development, the Alberta Research Council and the National Research Council have jointly established the Advanced Construction Technology Laboratory in the Advanced Technologies Department with the arrival of four research officers from the Institute for Research in Construction of the National Research Council. Particular emphasis will be placed on expert systems and other advanced computing techniques to provide solutions for the construction industry in Alberta.

Advanced Technologies staff carried out work under the Joint Research Venture program with: DATASPAN Technology Inc. to develop technologies for automating the conversion of paper maps to computer-encoded form; Pelorus Aviation Supplies (Canada) Ltd., developing microprocessor and microwave chip technology for building landing instrumentation for small aircraft; Applied Terravision and Gienow Building Products Ltd. to develop automated systems (see page 30).

In Brief:
(by sector)

Expert systems

Geophysical pattern analysis
Modelling

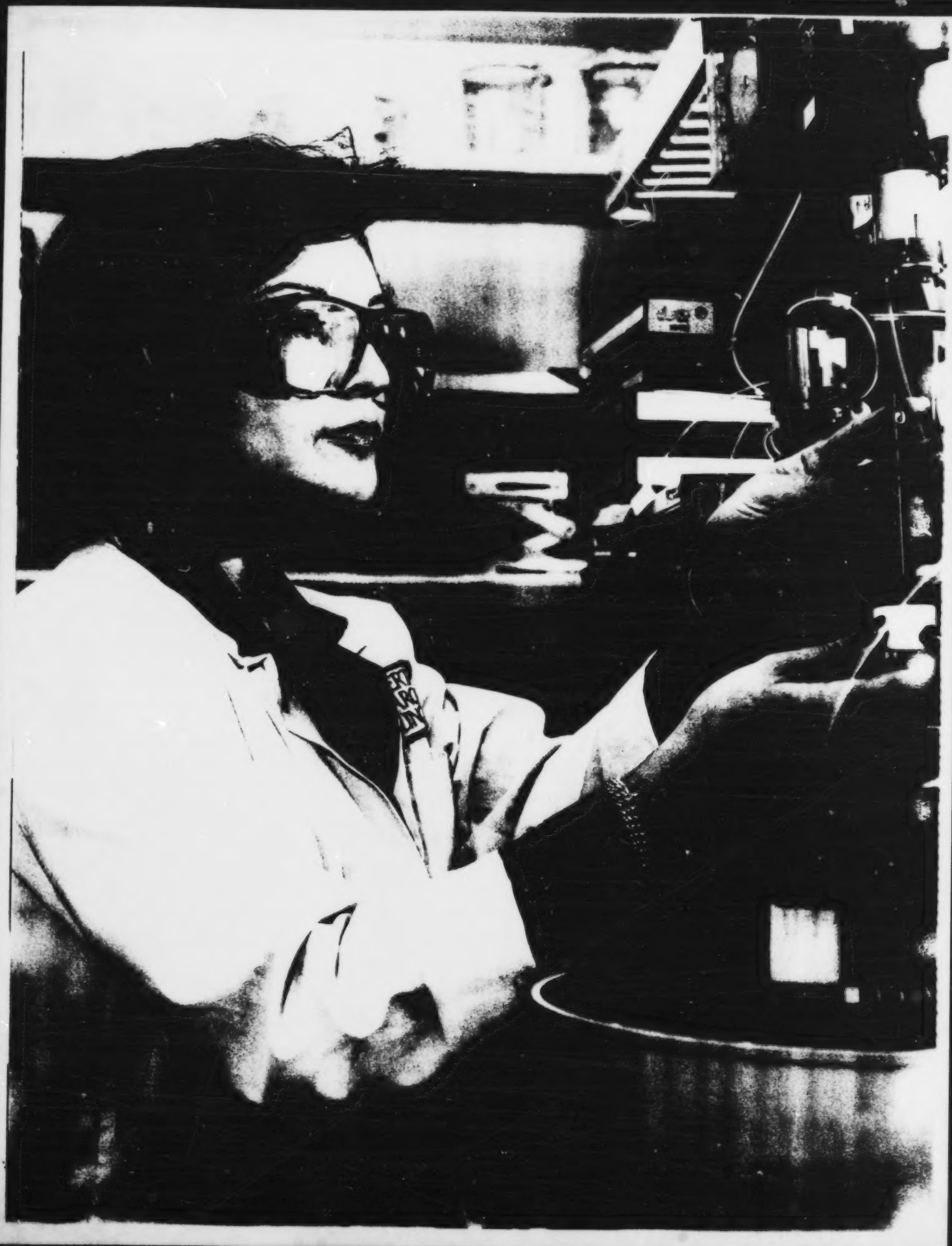
Training
Spills analysis

Robotics
Expert systems
AI applications
Advanced computing

Demonstration facility
Automation
CAD CAM
CNC CIM

Expert systems for highway design
Scheduling
Maintenance

Engineer Pat Feighan monitors the assembly operation in the Advanced Manufacturing Demonstration Facility.



Biotechnology

The Biotechnology Department's industrial research program is committed to solving technology problems on behalf of companies, large and small, where tangible benefit to the people of Alberta is evident.

Technical advances have been made in the work with Biosys, Palo Alto, California, and Philom Bios Inc., Saskatoon, Saskatchewan, intended to produce environmentally benign, biologically derived products. The biotechnology pilot plant continues limited preproduction manufacture of nematodes for Biosys, and the company now has three products on the market targeting different insect pests. Some larger-scale work has been done with Philom Bios to assist this firm during its development toward independent production of its agricultural herbicide and inoculant products.

An industrial contract research project deals with the development of a process for a biosurfactant, with application in the energy sector to enhanced oil recovery and heavy oil pipelining. Another project involves a process for nonbiologically active polyamide advanced materials. These materials have characteristics with commercial potential. A third project involved the largest-scale plant cell culture performed to date in North America, yielding a valuable biochemical.

To supplement the 15,000 litre fermentor, two 7,500 litre tanks were upgraded and engineered to become fully functional fermentors, completing the plan to furnish the 37,500 litres of capacity necessary to respond to contract research requirements. The department has recently expanded its technical expertise in biochemical engineering, cell culture, and downstream processing to complement its strong base in microbiology, biochemistry, and plant science.

In its applied research program, scientists are studying protoplast fusion and other plant cell culture techniques for application in investigations of novel methods for improving agriculturally important crops, and in the study of a variety of secondary metabolites.

Under its space biotechnology program, researchers continued biochemical engineering investigations with flight experimentation on the NASA-based KC-135 low-gravity aircraft. The Biotechnology Department's work on life support systems in space also led to an invitation from the Institute of Biophysics, U.S.S.R. Academy of Sciences (Siberian branch) for a Research Council specialist to visit the Academy.

Research collaborations are being developed with the local academic and industrial sectors, involving the techniques to both suspend and immobilize cell cultures. In addition, other external collaborations dealing with microbial sludge and tailing waste treatment are in place.

In the microbiology laboratory, the work on straight-chain fatty acids has resulted in cloning part of the gene that encodes one of the enzymes essential for branched-chain fatty acid synthesis.

Bioscientist Dr. Ella Keshavarz prepares protein purification system for study of enzymes from algae, part of a project to determine how plants flourish in areas of high salt concentrations. The answers could have implications for the reclamation of marginal land.

In Brief:
(by sector)

- Herbicide inoculant
- Biological insecticides
- Biological fertilizers

- Biosurfactants
- Biomodification of asphaltenes

- Bioremediation
- Manure liquefaction
- Tailings de-sludging

- Lignin degradation

- Low-gravity bioreactor design
- Advanced fermentation technology

- U.S. contracts
- Consulting: China, Zambia
- Scientific exchanges

- Biological insecticide: limited interim manufacture

- Heavy oil viscosity reduction for pipelining

Coal and Hydrocarbon Processing

In research and development to upgrade the quality and commercial value of heavy oil, coal, and natural gas, the Coal and Hydrocarbon Processing Department places emphasis on the needs of the private sector. As a result, more than 65 per cent of department revenues now come from client-funded research contracts.

The department has established a technological niche by using heavy oils for coal agglomeration. The Alberta Research Council and Electric Power Research Institute (EPRI), Palo Alto, California have led a consortium of 18 Canadian and U.S. resource and utility companies and government agencies which fund laboratory and pilot plant agglomeration process development. The program has three objectives: (1) upgrading Alberta subbituminous coal, (2) reduction of pyritic sulfur in bituminous coal, and (3) clean up of oily wastes. The latter is aimed at reclaiming hydrocarbons from contaminated wastes leaving environmentally acceptable soil and water.

Pyrite rejection is the objective of a subcontract with Southern Company Services, Inc., Birmingham, Alabama, funded by the U.S. Department of Energy under its Clean Coal program. The Research Council will receive $3.4 million over 42 months to generate data and design criteria for the construction of a 100 ton/day pilot plant in Wilsonville, Alabama. Up to 90 per cent of the pyritic sulfur can be rejected using the agglomeration process, thus allowing power companies to comply with sulfur dioxide emission control levels.

The Alberta Office of Coal Research and Technology (AOCRT) has been the major sponsor of combustion and gasification research. Integrated combined cycle gasification (IGCC) systems are expected to dominate the next generation of power plants. Hot gas cleanup technology is critical for higher thermal efficiency. Researchers are examining potential technologies suited to Alberta's low sulfur coals. The department has established kinetic models which enable it to determine the gasification reactivity of Alberta coals and to predict the composition of the product gases.

The largest program on heavy oil upgrading is jointly funded by the Alberta Oil Sands Technology and Research Authority (AOSTRA) and the Alberta Research Council. Two patent applications have been filed as the result of research on high-conversion processes and the mechanism of coke formation, and others are under development.

Catalytic processes are at the heart of the new generation of oil sand bitumen and heavy oil upgrading plants to be located in Alberta. A program aimed at designing catalysts, specifically tailored to Alberta feedstocks, has provided preliminary results which indicate these catalysts can improve conversion of the asphaltenic components in heavy oils.

Kasten-Eadie Technology Ltd. retained the department to generate design data for a process to partially upgrade heavy oil to pipeline specification quality. Pilot plant tests have proven the technical viability of this process.

Alberta subbituminous coal and Cold Lake heavy oil were selected as a feedstock pair in the development of Hydrocarbon Research Inc. coprocessing technology. The program, sponsored by the United States Department of Energy, EPRI, Ruhrkohle Oel Und Gas GMBH, West Germany, Mitsui SRC Development Co. Ltd. of Japan, Ontario-Ohio Synthetic Fuels Corporation, and the Alberta Research Council, has evaluated a series of North American, Japanese and German coals.

In other coprocessing work, the Alberta Research Council continued to provide technical and infrastructure support to Canadian Energy Development Inc. Process and engineering data have been collected from a 10 kg/h process development unit.

Under a major program with AOCRT funding, detailed chemical characterization

In Brief:
(by sector)

Heavy oil upgrading
Coal oil coprocessing
Coal upgrading gasification

Oily waste cleanup
Combustion
Ash utilization

Reactor diagnostics dynamics
Process instrumentation control

Joint programs: U.S., Japan, West Germany
Contracts: U.S., Indonesia

Slurry pipelining

techniques have been developed to examine chemical transformations which occur during coprocessing. AOCRT has also promoted the use of coprocessing-derived pitch as a raw material for the manufacture of specialty chemicals and carbon fibres.

Scoping tests have been completed on a series of bimetallic catalysts for the conversion of methane into ethane and ethylene in a jointly funded project of CANMET and the Alberta Research Council. The four best candidates have been selected for a more in-depth study with the objective of increasing the yields of ethane and ethylene to more than the 20 per cent now achievable. Modified zeolite catalysts have been prepared and evaluated under Fischer-Tropsch synthesis conditions for Multi-biotech. Several catalysts have proven to be highly selective for the production of kerosene-range aromatic compounds, which are suitable for blending into gasoline.

The Alberta Research Council has continued to actively participate in efforts to set up a national hydrogen technology research program administered by a restructured Hydrogen Industry Council. In a joint program with Alberta Energy, a project to develop a hydrogen producer/consumer networking model incorporating transportation and storage optimization is in progress. The model development is well advanced and a preliminary demonstration is planned in the near future.

The amount of sulfur found in coal is an important factor in the experiments conducted at the Alberta Research Council. Here, technologist Remy Estigoy places a coal sample in the LECO sulfur determinator for analysis.

Electronics Test Centre

Expertise in the specialized areas of product testing and certification enables the Electronics Test Centre to assist companies with the design and qualification of their products for sale around the world.

For the first time, the Electronics Test Centre has teamed with Alberta companies to bring a major contract to the West. The department joined with Amtek Testware of Edmonton and EDO Canada Ltd. of Calgary to successfully bid on the provision of an automatic test station used to maintain the Canadian Forces F-18 fighter aircraft. Work started in August and delivery is scheduled for the summer of 1990.

In 1989, the Electronics Test Centre worked on 307 projects for 155 companies, bringing the total since 1985 to 916 projects for 474 companies. Projected revenues for this year total $600,000, an increase of 15 per cent over 1988.

Major growth occurred in the product integrity and electromagnetic interference (EMI) sections under continuing accreditation by the Department of National Defence and the Standards Council of Canada, and the Electronics Test Centre's track record, established through an expanding list of successful projects.

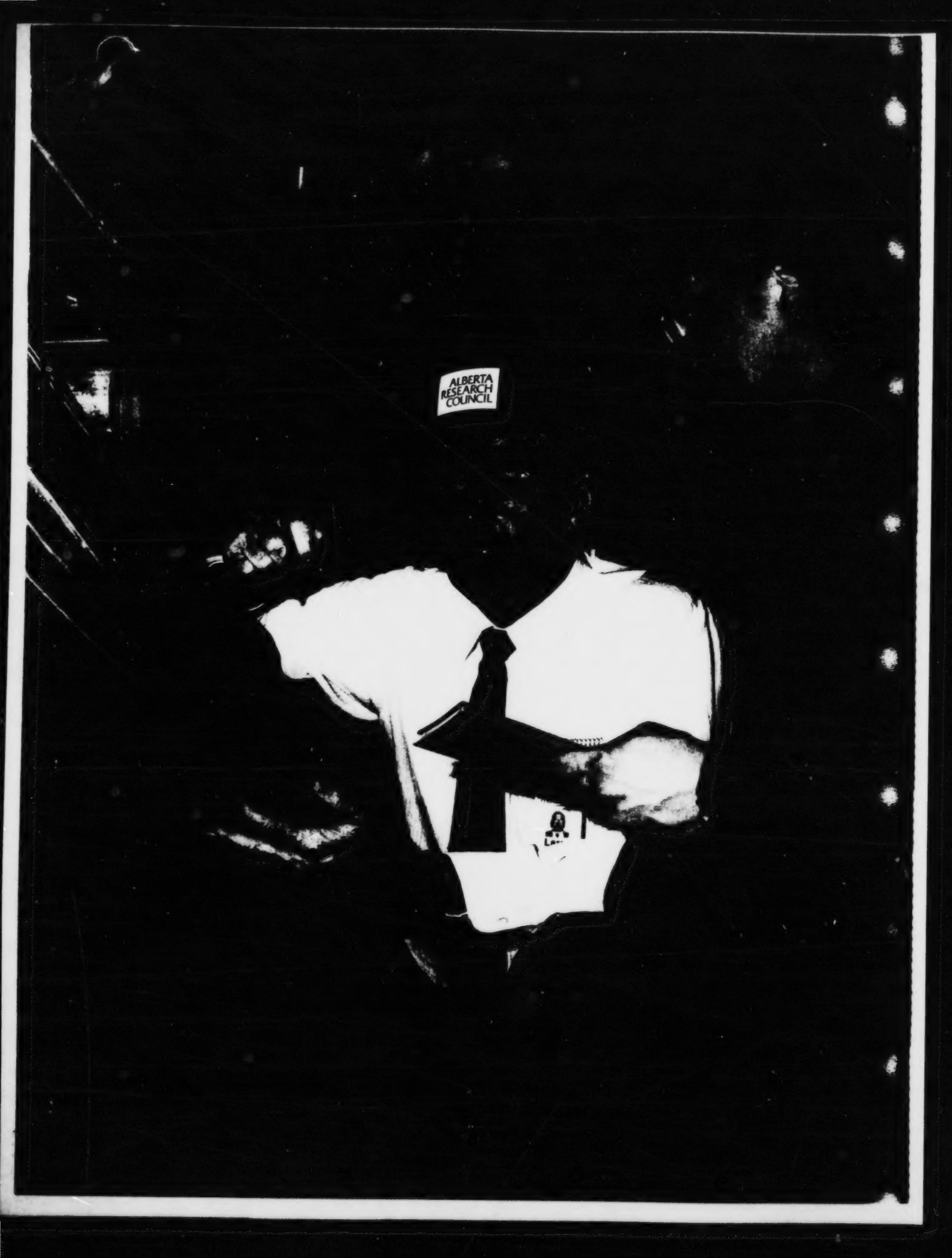
In the terminal attachment area, the Department of Communications accredited the Electronics Test Centre to perform the testing of telephones for hearing aid compatibility and the testing of private line modems.

In addition, the construction of an altitude chamber and specialized power conditioning equipment now enables the Electronics Test Centre to test commercial airborne equipment, a capability required by Alberta's growing aerospace industry.

In Brief:
(by sector)

- Electronic systems development and testing
- Testing and evaluation for companies outside Canada
- Acceptance of Alberta products
- Product testing and evaluation: electronics, telecommunications, avionics
- Quality assurance

The man behind the mask, researcher Duane Friesen braves sub-zero temperatures in the cold chamber to retrieve a piece of electronic gear undergoing rigid product evaluation.


ALBERTA
RESEARCH
COUNCIL

The Forestry Department was established to expand the scope of research and development in support of one of Alberta's key renewable resources. Memoranda of understanding have been successfully negotiated with Forintek Canada Corp. and the Forest Engineering Research Institute of Canada (FERIC). A similar agreement is in the final stages of negotiation with a counterpart organization in Denmark.

Revenues were provided through major contracts with Alberta Forestry, Lands and Wildlife and industry. Work continued on improving the properties and efficiency of production of oriented strandboards (OSB) and evaluation of Alberta tree species for OSB production. Major cooperative projects with industry to investigate new resin systems were undertaken, along with several industry-led investigations on the use of agricultural and municipal wastes, such as flax, straw, and waste paper, as feedstocks for the production of innovative new structural and general use panels.

Seven patent applications, covering innovations in the development or manufacture of composite wood products, were made during the year in Canada and/or the United States.

The Standards Council of Canada accreditation of the testing laboratory was extended. Laboratory staff carried out the first mill evaluation in Canada to the new CSA 0325 performance standard for structural panels.

Initial contract work sponsored by Forestry Canada and the Alberta Forest Service, under the Forest Resources Development Agreement, involved an evaluation of the land information needs and Geographic Information System (GIS) implementation plans of the Forest Management Agreement (FMA) holders in Alberta. A final report, Collective Strategy for Land Information Systems for Forest Management in Alberta, was submitted to the sponsoring agencies on behalf of FMA holders.

In response to the report's recommendations, the Alberta Forest Service, together with the FMA companies, is now in the process of identifying common and mutually beneficial data specifications, formats, and exchange standards for future forest inventory work in the province – an important step towards the development of a land information system for forestry in Alberta.

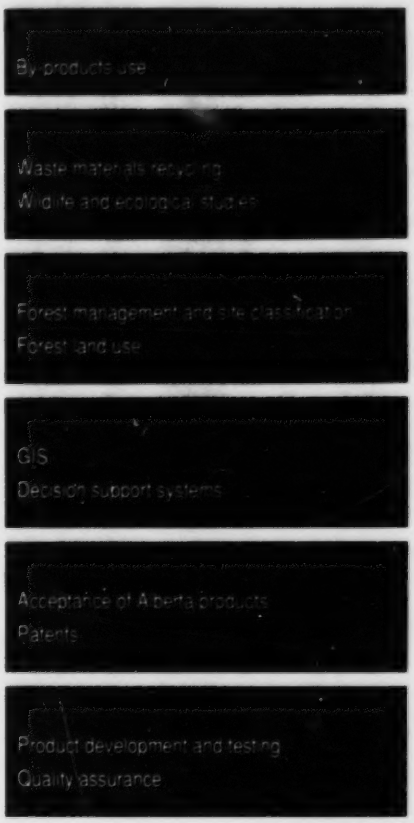
Site classification needs (mapping, evaluation, engineering and biological interpretation) expressed by several forest products companies are currently being pursued in collaboration with Forestry Canada staff. The two areas of work include the development of practical technical transfer programs for forest products companies in the application of existing information; and the development and testing of predictive site classification mapping techniques using existing information and knowledge bases, GIS, and remote sensing technologies.

The main research activities of a wildlife project involve the development, manufacture, and marketing of trapping devices that will allow the most humane capture of furbearers. This year, the Research Council began a major project involving the development of devices and a system for the humane capture of arctic fox, long tailed weasel, marten, lynx, and raccoon. This work, being carried out in facilities at the Alberta Environmental Centre, Vegreville, is sponsored by the Fur Institute of Canada.

A release program for fisher is planned at the conclusion of the work.The intent of this program is to reestablish fisher in a specific area and monitor the progress of these animals over an extended period.

Safe loading limits for structural wood components are needed by panel products manufacturers. This stress skin panel, used in light industrial buildings, underwent 1000 days of sustained loading for normal conditions prior to destructive loading. Technologist Leo Regnier and research engineer Dr. Lars Bach examine the results of destructive testing.

In Brief:
(by sector)



Alberta Geological Survey

The Alberta Geological Survey provides geoscience information needed for environmentally responsible resource exploration and development. Geological support for the Alberta Oil Sands Technology Research Authority (AOSTRA) underground test facility (UTF) was the main priority in its current strategic research program funded entirely by AOSTRA. Documentation of the UTF geologic framework is fundamental to developing and refining the new technology used at the UTF site. Activities range from detailed core work to mapping, calculating reserves, and planning drilling programs for UTF expansion.

The joint oil sands geology program, is funded equally by the Alberta Research Council, Alberta Energy, and AOSTRA. Resource characterization of Athabasca Central and Athabasca South provides the framework for oil sands development in these areas. In reservoir analysis, the scaling up of values for reservoir parameters, such as permeability, from core to reservoir grid scale, continued with the use of numerical and physical flow models.

The coal geology program, jointly funded by Alberta Energy and the Alberta Research Council, completed a three-year study of the distribution of coal quality parameters of Alberta coals. Coal quality data are being put in a geological framework, with models that can be used to predict coal quality variations. The program has been extended for another year.

A user-friendly, efficient digital coal database has been prepared and a demonstration of Geographic Information System (GIS) application to geology has been prepared. Regional mapping results in the Grande Cache, Hinton, and Coalspur areas were added to the database and GIS.

A geological study of the Peace River Arch area, a cooperative effort between the Alberta Geological Survey and the Institute of Sedimentary and Petroleum Geology in Calgary, is nearing completion. Numerical basin evolution and hydrocarbon accumulation models were implemented.

Work continued on the Geological Atlas of the Western Canada Sedimentary Basin, a project engaging more than 150 volunteers from industry, universities and government. The atlas will provide a comprehensive geological framework needed to find and exploit oil and gas at the mature stage of development of the basin.

Under contract to Alberta Forestry, Lands and Wildlife, the Alberta Geological Survey conducted a study which shows that Alberta has substantial reserves of minerals essential to pulp and paper production.

Alberta Energy commissioned the Alberta Geological Survey to conduct a preliminary assessment of the metallogenic database for northeast Alberta, as a basis for formulating exploration strategies for the Canadian Shield area.

Studies of Tertiary gravel deposits indicate significant resource potential for recovery of gold and other placer minerals as by-products.

In Brief:
(by sector)

- Oil sands geology
- Coal geology
- Petroleum geology and basin analysis
- Deep waste disposal
- Mineral resources assessment for pulp and paper industry
- Numerical modelling
- Image analysis
- Log analysis
- GIS
- Evaluation: oil sands, Cuba, Indonesia, clay, Guyana
- Scientific exchanges: China, U.S.A.
- Mineral separation equipment testing, process certification
- Mineral clay deposits assessment and data bases
- Aggregate inventory

The Alberta Geological Survey provides sand and gravel data used by planners, extraction companies, road and building contractors, and resource managers. Geologist Dr. Don Scafe records his observations at a sand and gravel pit near Edmonton.

Materials and Testing

The Materials and Testing Department is organized to focus the Alberta Research Council's activities in advanced materials research and materials testing.

The advanced materials group continued to develop low-pressure, inert gas plasma spray technology for ceramic/metal composite and ceramic coatings. Optimization of spray parameters to achieve coatings with properties that conform to industrial standards is the chief activity.

Technology and information transfer to industry included technical information on ceramic coatings for plungers of horizontal reciprocating pumps, the production of fine-grained silicon carbide, coating of rock bit bearings with diamond or cubic boron nitride, and testing of a novel copper anode with extended lifetime for a plasma spray gun.

The advanced materials group developed into a Western node of an advanced materials network composed of the Canadian Advanced Industrial Materials Forum (CAIMAF) and the Canadian University-Industry Council on Advanced Ceramics (CUICAC).

The gasoline and oil testing laboratory celebrated 50 years of successful petroleum testing and service. Standards Council of Canada accreditation was renewed. At the request of the Petroleum Association for the Conservation of the Canadian Environment, the laboratory has developed a standard test method for characterizing Canadian automotive gasolines. Testing of various dyes being considered for use in identifying tax exempt fuels in the province was also carried out for Alberta Treasury.

Performance testing is important before introducing a new product to the market. Ketchup, mustard, lipstick, fruit juices, shoe polish dot the squares as technologist Jim Melnichuk conducts stain resistance tests on samples of a countertop designed for kitchen or bathroom use.

The chemical, mechanical and metallography, and plastics testing laboratories continued to perform industrial materials evaluation and development. This included work on canola seed pesticide coating products for Growtech Limited.

Industrial materials testing broadened the scope of Canadian General Standards Board testing acceptance with the addition of surgical gloves and canola packaging to a list that already includes expanded polystyrene insulation, polyethylene vapor barrier, and cellufibre insulation. Standards Council of Canada accreditation of the testing facilities for industrial and construction materials is under consideration. This testing has led to direct involvement in product development work with several manufacturers in Alberta.

Under a joint research project with Esso Resources Canada Ltd., researchers examined properties of materials for possible selection as protective liner in transmission pipes.

The membrane research group participated in the hydrogen technology research program initiated by Alberta Energy (supported by the Alberta/Canada Energy Resources Research Fund) and has been actively engaged in research on hydrogen separation and purification technology. The project involves the development of hollow-fibre-based separation methods incorporating sorption and permeation processes for improved hydrogen recovery from various gas mixtures in the hydrogen production and utilization industries.

The analytical chemistry laboratory provided analytical support to: the Terrain Sciences Department in a contract to develop methodology for the analysis of trace elements in contaminated soils; the Oil Sands and Hydrocarbon Recovery Department for the characterization of complex petroleum-based products; and to the Materials and Testing Department for analysis of residual pesticides in plastic containers.

In Brief:
(by sector)

- Seed-coating
- Sulfur fertilizer
- Sulfur herbicide

- Hydrogen separation
- Gasoline testing

- Waste exchange
- Polymer recycling
- Environmental monitoring
- Containment pond liners

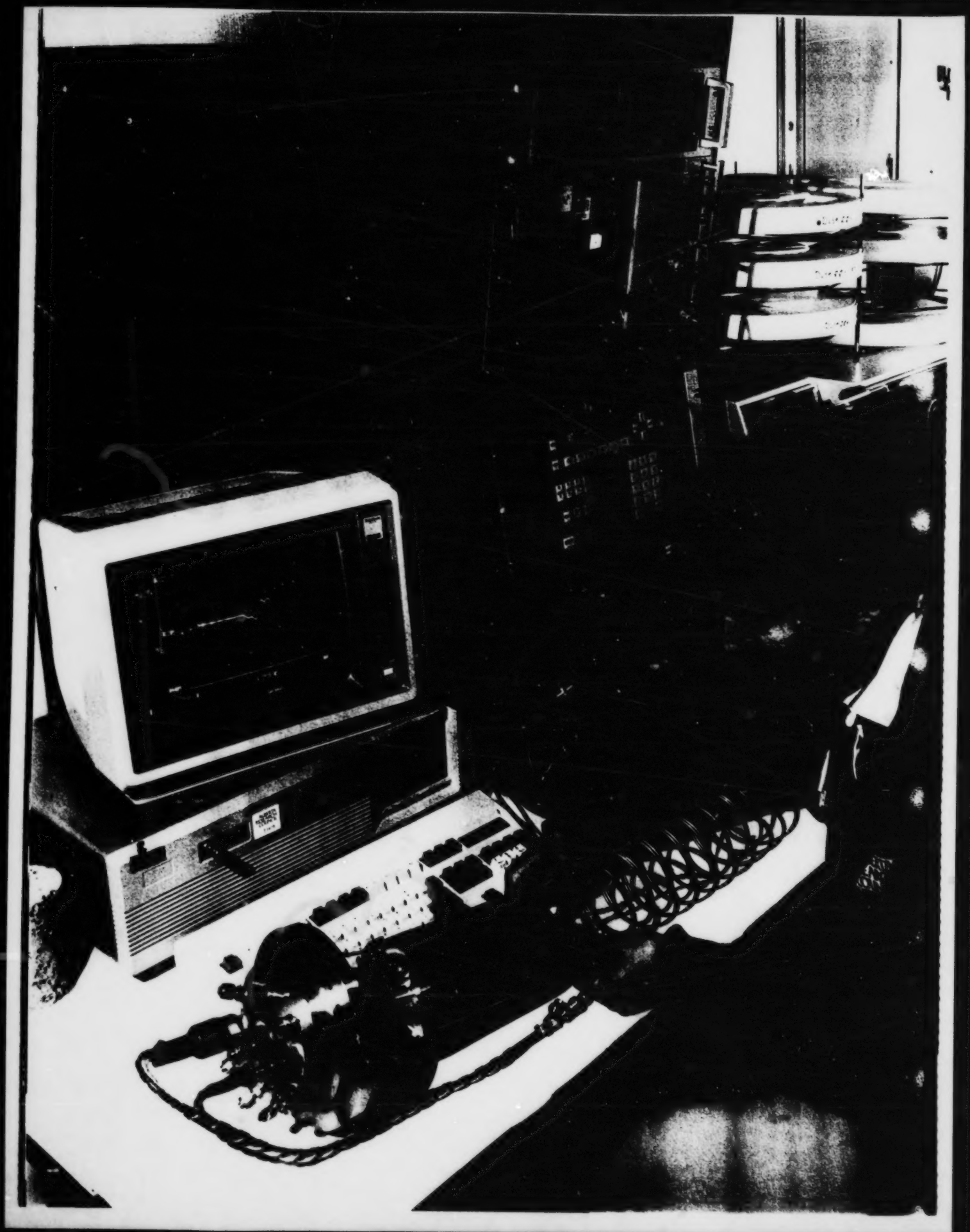
- Coating of debarking knives
- Wood chemistry

- Ceramic coating

- Scientific exchange

- Product prototypes
- Product testing

- Clay analysis
- Extractive metallurgy



Oil Sands and Hydrocarbon Recovery

The Oil Sands and Hydrocarbon Recovery Department conducts many of its research investigations under programs supported by AOSTRA. The strategic research program, funded entirely by AOSTRA, moved into its third year of applied research and development to apply concepts, results and insights gained from laboratory study to individual field situations.

A recently installed pump simulator, capable of reproducing field conditions, was used to study the problem of reduced pumping efficiency due to gas and solids present in the oil. Observation of the effects of the solids and gas on the valve ball motion has resulted in design changes that will improve pump efficiency and reduce wear and downtime.

Horizontal wells in heavy oil reservoirs can dramatically increase oil recovery. The combination of unconsolidated oil sands and relatively low velocities often results in sand entering and accumulating in the horizontal wells. A flow loop in the Research Council's oil sands laboratories was used to develop novel strategies for enhancement of sand removal that are ready for field application.

Under the industry access core research program, jointly funded by AOSTRA and Coal and Hydrocarbon Processing, a patent disclosure was made for field application of a novel technology using foams to improve areal conformance. The new concept was developed to improve the rate of foam propagation in the reservoir.

Department engineers and analytical staff worked on contracts with OSLO, a consortium of six major oil companies, to evaluate a variety of extraction technologies and tailings management strategies in pilot-ing studies. These studies will be used as part of the design basis for commercialization of the process in a new oil sand extraction plant in northern Alberta.

In cooperation with the Alberta Geological Survey, a project was completed with Suncor Inc. on a study of core from the Burnt Lake reservoir to assess the likelihood of formation damage by fines migration or geochemical reactions.

Projects to study the effects of different in situ recovery processes on the recovered oil were continued in contracts with CANMET, BP Canada Inc., and Mobil Oil Canada Ltd. Each of the studies used a different recovery process and provided information on the changes in composition and physical properties of the oil that could be expected when using these recovery processes.

In a joint project with Syncrude Canada and CANMET, Alberta Research Council scientists are studying the fundamental properties of tailings sludge produced by the hot water extraction process used in commercial oil sand mining operations.

Other projects with Alberta industry are aimed at treating oily sludges from a variety of industrial operations. One such study was performed in cooperation with David Bromley and Associates.

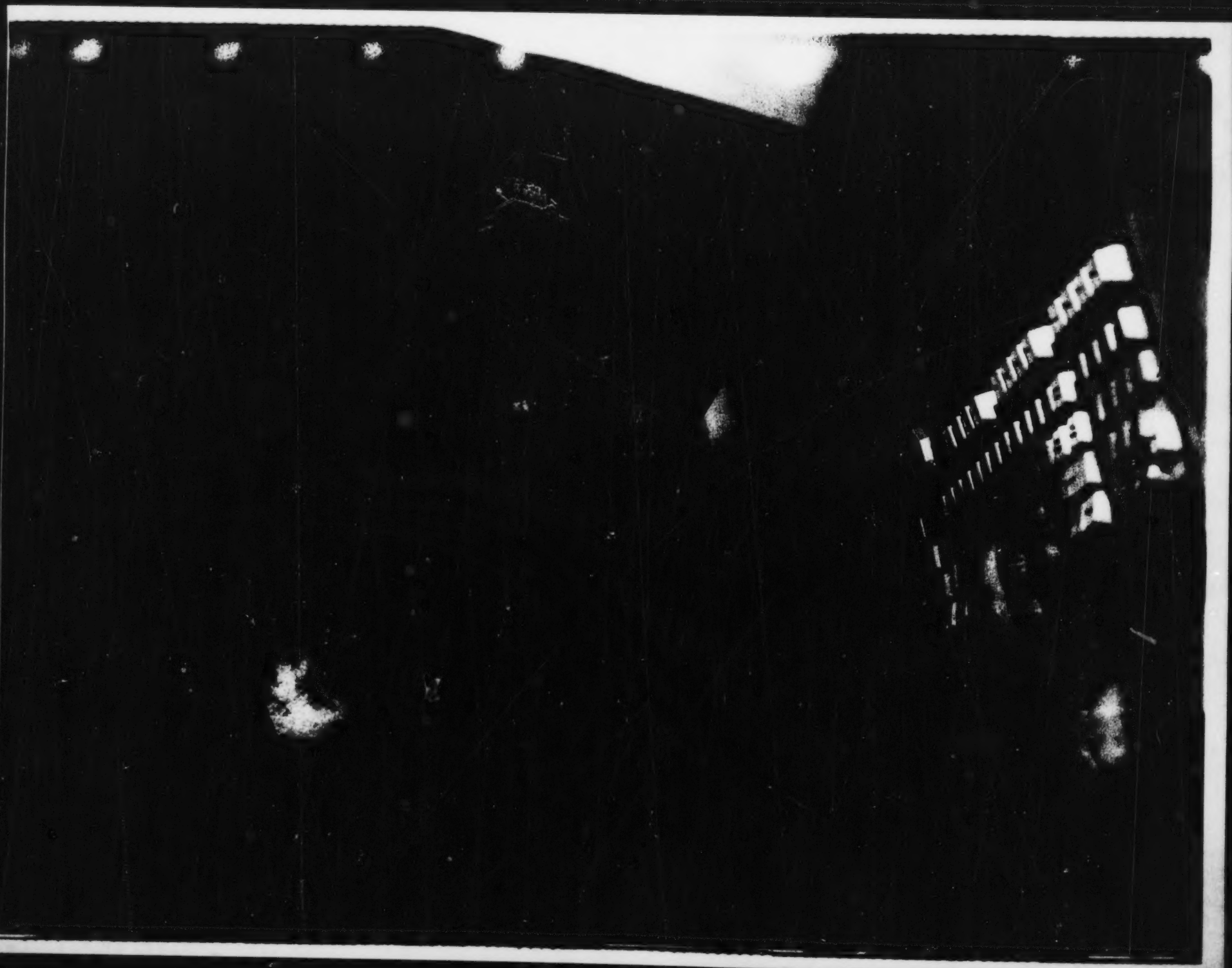
Since 1987, three studies were completed employing Canadian Energy Research Institute models, developed by the technical and economic evaluations group. These studies reported on the potential for coal-derived synthetic fuels, Canadian crude oil supply and demand, and critical issues in electric power planning in the 1990s.

A project was completed jointly with the Advanced Technologies Department and with HEP Pumping Systems of Calgary in which a microcomputer-based control system was developed to control the HEP pump. Such adaptive control will improve pumping efficiency and control of the pumping operation.

Combined X-ray computed tomography and acoustic measurements are used in seismic monitoring of enhanced oil recovery floods. Technologist Gerald Kissel assembles apparatus for conducting experiments.

In Brief:
(by Sector)

- Oil recovery technology development
- Economic modelling
- Oil sands tailings study
- Oil field sludges
- Geochemistry for waste water injection
- Computer modelling
- Computer pump controls
- Waxy crudes study
- Oil deposit evaluation
- Research program development
- Filter design improvements
- Inorganic geochemistry
- Pipeline transport of heavy and waxy crudes



The Resource Technologies Department is dedicated to the application of technology for developing and managing Alberta's natural resources.

Growing concern over the possible impact of global climate change on Alberta was addressed in a climate group project, jointly sponsored by four provincial government departments: Alberta Agriculture, Alberta Environment, Forestry, Lands and Wildlife, and Technology, Research and Telecommunications. "Towards a strategy for adapting to climate change in Alberta" describes possible future climates based on global climate models, reviews trends within the climate record, and develops planning requirements to cope with possible climate changes.

Several projects related to rainfall rates and severe storms were completed. These included probable maximum precipitation estimates for use in dam design in the Eastern Slopes which were defined in a contract with Northwest Hydraulic Consultants Ltd; an international project evaluating the differential propagation phase from the S-band polarized radar for estimation of intense rainfall rates; use of the C-band radar to provide high resolution, radar-derived rainfall measurements for the Alberta Hail and Crop Insurance Corporation; and a project with Boeing Aerospace, Seattle, to provide precipitation intensity information to establish guidelines for aircraft engine operation during heavy precipitation.

The spatial information technologies group is active in the development of standards, software development, training, and demonstration of computer technology in handling spatially distributed data.

Dr. Marianne English analyzes radar-derived rainfall amounts from an Alberta storm.

Establishing the feasibility of applying GIS technology to the management of land records, demography, and utilities for small municipalities is the objective of the Alberta Planning Board LRIS pilot project. Implementation is under way, with participants including the Alberta Planning Board, Alberta Municipal Affairs, Forestry, Lands and Wildlife, and Transportation and Utilities departments.

In addition to a renewed emphasis on water quality, including the hydraulics of dispersion of pollutants from point sources and the role of sediments in contaminant cycling, the surface water engineering group is continuing field programs to develop and evaluate technology in ice engineering, hydrology, and river mechanics.

A strain gauge network designed to measure ice forces due to thermal expansion and wind drift of solid ice sheets, was installed in two bridge piers in the Oldman Reservoir. Information from the measured ice forces will be used to improve the design criteria for dams and ancillary structures.

In order to generalize the findings of the recently completed project that measured river ice forces at a few specific locations, factors controlling both the breakup and the mechanics of ice impacts on hydraulic structures were defined to develop regional patterns of ice forces on river structures. Alberta Transportation and Utilities, which co-sponsored the project, will use this information in the design of new structures.

In support of cooperative efforts between Alberta Transportation and Utilities, universities, contractors, and consulting firms, the transportation group is providing technology and expertise to field projects. An arch railway overpass structure of reinforced concrete has been instrumented for strain, stress, and deformation measurements. Responses recorded during the construction will be compared to design parameters.

In Brief:
(by sector)

- Climate change
- Weather radar
- Hydrology
- Effluent dispersion
- River ice pollution
- LRIS GIS
- Remote data acquisition
- Computing
- Dataloggers and sensors
- Weather radar training
- Radar polarization
- Pavement projects
- Biotechnical control systems
- Aviation technology
- Pavement management
- River engineering
- Geotechnical engineering

Terrain Sciences

Terrain Sciences is a multidisciplinary department concerned with natural resource management. In response to increasing demands from municipalities, the Terrain Sciences Department stepped up its soil inventory activities during 1989. A pilot project to demonstrate integration of soil survey and farmland assessment information requirements was completed in the Morinville area. This project was conducted in support of the Alberta Planning Board's (APB) project to develop a pilot land related information system to support municipal planning. Department staff also contributed soils and groundwater expertise to the development of applications for the Map Analysis Techniques for the Land Use Planning (MATLUP) component of the APB pilot study.

A pilot project in the Municipal District of Rocky View has been undertaken to develop new methods for the production of soil inventory products. Using existing, reconnaissance-scale soil maps and data from farmland assessment and soil conservation inventory records, this technology may enable acceleration of the production of some soil surveys.

A five-year soil erosion study for Farming for the Future was completed. This research resulted in a better understanding of the soil relocation process and development of a conceptual model of soil redistribution on the landscape. In cooperation with Agriculture Canada and partially funded by Alberta Agriculture, a three-year soil survey in St. Paul County was completed.

Surrounded by flowering canola near Morinville, terrain scientists Bob Howitt and Brenda Sawyer collect soil survey data to support farmland assessment and land use decisions by planning agencies.

A multidisciplinary team from the Terrain Sciences and Resource Technologies departments worked with Alberta Tourism to produce a series of interpretive models for evaluating the potential for tourism development in the Drumheller area.

Terrain Sciences staff continued to provide support to the Alberta coal industry through involvement in the multiparticipant downhole geophysics project. Studies show that geophysical logs can be used to detect and classify deformed bedrock on the basis of the degree of deformation.

The use of shallow groundwater resources by oil companies is a source of conflict between the companies and local residents. At the request of Stanley Associates Engineering Ltd. and Husky Oil, Terrain Sciences staff conducted an aquifer test to investigate the connection between deep aquifer systems and overlying shallow aquifers and surface water. Results indicate that although aquitards show evidence of fracturing at great depth, the effects of pumping deep aquifers are unlikely to be transmitted upward to more shallow zones for at least several decades.

The department enjoys long-term reclamation research relationships with Smoky River Coal in the Grande Cache area, and Luscar Ltd. in the plains region of east-central Alberta. The Smoky River Coal project assessed the climatic impact on tree and shrub establishment. Results will lead to the development and refinement of the region's operational reclamation procedures. Results from the Luscar Ltd. project indicate that current soil reconstruction techniques are appropriate; soil moisture and bulk density characteristics of reconstructed sites are comparable to the area's unmined soils.

In Brief:
(by sector)

- Soil surveys
- Erosion groundwater research
- Geological modelling for surface mine planning
- Land reclamation
- Waste characterization
- Land based treatment and disposal of oily sludges
- GIS application
- Technology transfer
- Scientific exchange
- Sampling and monitoring equipment design and adaptation

Joint Research Ventures

The Alberta Research Council's Joint Research Venture Program has continued to foster its commitment to working with the private sector. By providing a vehicle for Alberta's small- and medium-size industries to participate in cost-shared research projects, the Alberta Research Council helps to accelerate the commercialization of new products, processes, and services being developed by these companies. In the five years the program has been operating, more than 20 Alberta companies have been helped through joint research ventures to develop their technologies.

New projects include a joint research venture between Gienow Building Products Ltd. and the Advanced Technologies Department for the automation of the window manufacturing plant production line. This joint research venture will initially improve on the efficiency of the production lines through the installation of additional automatic machinery and will lead to the implementation of a computer-integrated manufacturing (CIM) system for Gienow. Having a CIM system will result in more cost-effective manufacturing and enable Gienow to compete in world markets. Besides capturing a greater percentage of window sales in Alberta, Gienow plans to expand its U.S. and Pacific Rim markets.

The first joint research venture project with an Edmonton company was started this year when Myrias Research Corporation began work with the Oil Sands and Hydrocarbon Recovery Department. The project is for the development and application of parallel computing for the petroleum industry. The work focuses specifically on reservoir simulation, seismic processing and fluid dynamics. The software programs developed under this project will help to ensure that the province's petroleum sector maintains its world leadership.

The development of automatic generation of 3-D stereo images from satellite data is the objective of a new joint venture between Applied Terravision Systems Inc. and the Advanced Technologies Department. Applications for this technology exist in the world petroleum exploration industry and industrial route planners.

Maloney Steel Ltd., Calgary, is working with the Oil Sands and Hydrocarbon Recovery Department to develop an advanced oil/water separation process for use by major oil producers. The project is expected to produce a workable mathematical model which will be used for selecting and sizing separation equipment and determining features affecting performance. A portable test unit will be built for field testing and later commercialized by the company.

Another project is under way with Microtech Well Logging and Wellsite Consulting Ltd. of Calgary to develop a computerized wellsite logging system. The objective of the joint research venture is to design and build a fully automated, portable gas analysis instrumentation prototype for hydrocarbon analysis and to develop software which will assist the wellsite geologist in creating a geological strip log by accessing data which has been entered into a unique geological/hydrocarbon database.

In Brief:
(by sector)

Finely divided sulfur as a fertilizer

Inertial pig for gas pipelines
Parallel computing

3-D stereo imaging
Airborne microwave landing systems
Expert systems

Plant automation

Industrial Technology Advisor Network

The Industrial Technology Advisor Network (ITAN), a collaborative program between the Alberta Research Council and the National Research Council, was established this year as an outgrowth of a relationship which has existed between the two organizations for more than 30 years. ITAN broadens the base for delivery of services which provide for the technical needs of Alberta-based small- and medium-size enterprises.

Industrial technology advisors (ITAs) are located in Edmonton, Calgary, Lethbridge, and Red Deer and provide a confidential, in-plant technical support service to a broad range of companies, typically in the manufacturing and service industries. A special effort has been made to improve the take-up and application of new technologies for resource industry supplier companies and the construction industry.

Industrial technology advisors provide technical information and advice applicable to the needs of the firm. Alberta Research Council laboratory departments are used as sources of technology wherever possible; however, ITAs have access to other sources of technology within Alberta's technical centres and universities, and as part of the national IRAP network of NRC, have access to virtually all Canadian sources of technology.

The NRC collaboration provides for national networking and access to foreign technologies through Canadian posts in Europe, U.S., and Japan. ITAs accept the mandate to provide the best technology for the need of the firm in order to solve technical problems and assist in the development of new products and services.

During 1989, ITAs assisted approximately 4000 firms in the province and arranged for IRAP financial support for 120 student projects, 350 technical consultation and testing projects, and 45 medium-term product developments totalling $3.2 million. Alberta Research Council laboratories participated in a number of these projects by providing technical support. The private sector consulting industry in Alberta benefits from IRAP-funded projects by providing the technical services required.

ITAN staff are dedicated to serving the needs of their client firms and represent a committed outreach component of the Alberta Research Council, conveniently located throughout the province.

In Brief:
(by sector)

- Remote sensing equipment development
- Food product development
- Equipment development and improvement
- New product development and improvement
- Access to foreign technology
- Industrial engineering services
- Technology awareness
- Application of advanced industrial materials

Industrial Waste Management

The management of industrial wastes is important to the health, well-being, and quality of life of all Albertans. As governments, private industry, and individuals grapple with the environmental issues surrounding waste management, research is being conducted on the identification and treatment of industrial wastes from tailings sludge to waterborne effluent. The Terrain Sciences Department is coordinating a corporate initiative to identify and integrate the variety of waste management expertise available at the Alberta Research Council.

The Alberta Research Council's contract with Alberta Environment was extended to continue the operation of the Alberta Waste Materials Exchange for another year. The exchange acts as an information clearing house for waste materials produced through industrial activity in Alberta and is known throughout North America and in Pacific Rim countries.

Investigating industrial wastes is already a major activity in a number of Alberta Research Council departments, and the following is a summary of current activities.

The Oil Sands and Hydrocarbon Recovery Department is involved in several small projects for industry and AOSTRA dealing with treatment of tailings sludges, while Coal and Hydrocarbon Processing Department researchers are working on cleanup of soil contaminated by coal-derived tar, heavy oil, and other petroleum-derived products. The Biotechnology and Forestry departments are evaluating various fungal species for accelerated biodegradation of lignin wastes.

The Materials and Testing Department assisted the Edmonton Recycling Society in assessing Japanese and European technology used in the recycling of mixed plastics recovered from municipal solid wastes, in particular, the European equipment used to reconstruct plastics into a useable product. It was important in the evaluation of the technology that commercial viability and assessment of markets be included. The result of this mission will be the implementation of plastics recycling in the City of Edmonton by the Edmonton Recycling Society as part of its municipal waste management processes. Activities are under way to develop a proposal to the City of Edmonton regarding a proposed waste management centre in northeast Edmonton for the recycling of waste oil, and the reduction of the volume of solid wastes and sewage sludges through pyrolitic processing.

Research in the Terrain Sciences Department has been focused on the land-based treatment and disposal of a variety of industrial wastes commonly produced by the energy industry, including drilling wastes, oil sand tailings, oily wastes, coal-cleaning waste, and gas plant sludges. The results of a three-year project jointly funded by the Alberta Heritage Savings Trust Fund and the Alberta Research Council, completed in 1989, support the development of guidelines for disposal of drilling-mud-solids that maximize environmental safety and cost-effectiveness.

Terrain Sciences and Oil Sands and Hydrocarbon Recovery staff worked on a study of the extraction and characterization of humic substances from oil sand sludges and their interaction with clay surfaces. Results showed that adsorption of the material on to clays was almost irreversible, indicating high binding energies. In greenhouse experiments, vegetation growth and trace element concentrations were assessed to determine criteria for landspreading and provide recommendations for environmental-

ly safe disposal rates. Field experiments were established in 1988 in cooperation with ESSO Resources Canada Ltd.

Scientists from the Terrain Sciences Department have initiated a study with Luscar-Sterco(1977) Limited and Obed Mountain Coal Company Limited to develop environmentally sound and cost-effective techniques for reclaiming areas affected by coal-cleaning waste disposal.

In cooperation with the Canadian Petroleum Association, scientists in the Terrain Sciences Department tested, modified, and developed several digestion methods for analysis of gas plant sludges. The Alberta Research Council hosted a workshop to evaluate the final recommendations and establish procedures for testing of the methods by private analytical laboratories.

The expansion of the forest products industry at Hinton, Whitecourt, and Athabasca may result in an increase in the volume of effluent injected into the Athabasca river system. This could lead to possible deleterious effects on water quality, particularly during winter when the dispersion of effluents is at a minimum because of low flow rates and diminished re-aeration. In work co-sponsored by Alberta Environment, the Resource Technologies Department's surface water engineering group defined the hydraulic and mixing characteristics of the Athabasca River between Hinton and Athabasca by measuring river channel characteristics and conducting tracer studies under ice conditions. This work established modelling parameters, unique for each river or section of river, to assess mixing and longitudinal dispersion for environmental impact assessment.

Accurate winter discharge records are required for water management and for the safe disposal of effluents into rivers. Such measurements are complicated during ice cover development, particularly when frazil ice dominates the process. In a joint project with the Water Survey of Canada, river ice formation processes were documented and a model was developed and evaluated on several rivers, so that the timing and severity of freeze-up can be forecast, and the temporary storage losses can be calculated to improve the accuracy of discharge estimates.

Surface water researchers use fluorescent dyes to determine how pollutants are dispersed in Alberta's rivers. Technologist John Thompson injects tracer dye under the ice cover of the Athabasca River, while Alberta Environment staff, seen in the background, collect water samples for evaluation.

Research and technology development aimed at developing tools for monitoring and regulating air quality is a major component of the Resource Technologies Department's waste management program. Of particular note is the work with Alberta Environment involving the adaptation of models to simulate the transport, transformation and deposition of atmospheric pollutants, such as acid rain.

The publication of *Acidic deposition: Sulfur and nitrogen oxides* marks the conclusion of the involvement of the Terrain Sciences Department in a major interdisciplinary research program carried out by the government/industry Acidic Deposition Research Program. The research program included scientific input from both the United States and Canada, resulting in a volume that provides comprehensive coverage of the effects of acid deposition. Terrain Sciences staff contributed a chapter dealing with the present and potential effects of acidifying deposition on Alberta soils.

In a cooperative project with the Kananaskis Centre for Environmental Research (University of Calgary), Resource Technologies staff reviewed photochemical models so as to develop an ambient hydrocarbon standard and to prescribe nitrogen oxides emissions to ensure acceptable ozone levels in Alberta.

International Activity

The Alberta Research Council is continuing to foster international links with research institutes and industry in other countries as a means of encouraging technology transfer both into, and out of Alberta.

As a stimulus in the Pacific Rim, the Alberta Research Council now has a representative attached to the Government of Alberta Tokyo offices. In addition, senior management and research staff from a number of departments made overseas visits to countries from Cuba to China. The Alberta Research Council also has a number of visiting scientists from abroad working in its laboratories. Some activities are briefly described below:

Biotechnology. The Biotechnology Department's work on life-support systems in space led to an invitation from the Institute of Biophysics, U.S.S.R. Academy of Sciences (Siberian branch) for a Research Council specialist to visit the Academy. Under a United Nations development program for Third World countries, an Alberta Research Council bioscientist was invited to evaluate the potential for development of a biotechnology industry in Zambia.

Coal. The Alberta Research Council has evaluated a series of North American, Japanese, and German coals under a program to develop Hydrocarbon Research Institute coprocessing technology. This work is being sponsored by the U.S. Energy Department, the Electric Power Research Institute and the Hydrocarbon Research Inc., Ruhrkohle Oel Und Gas GMBH, West Germany, and Mitsui SRC Development Co. Ltd., Japan.

Forestry. The Forestry Department is a full participant in the International Energy Agency (IEA) working group program on predicting the consequences of intensive forest harvesting on long-term productivity. An invited paper was presented at a workshop held in March in New Zealand. The IEA has asked the Research Council to continue coordination of activities related to GIS applications.

Geology. At the request of AOSTRA and MINBAS (Cuban Ministry of Basic Industries), an Alberta Research Council geologist visited Cuba to evaluate bitumen deposits in that country. The Alberta Geological Survey participated in a scientific exchange with the Research Institute of Petroleum Exploration and Development of the China Petroleum Corporation.

Oil Sands. A contract with the Department of Highways of the Government of Indonesia, funded by the World Bank to evaluate asbuton deposits in Indonesia, was completed. The work has resulted in a number of proposals for the development of the deposit.

Alberta Research Council scientists and engineers worked with waxy crudes from oil wells in the North Sea, Southeast Asia, and China. The difficult problem of restarting a pipeline filled with a waxy crude was studied for a Japanese company, using the pipe test loop at the Research Council's pilot plant.

Scientists and engineers visited research institutes and oil fields in China to observe their operations and to present lectures, while scientists from China contributed to various research projects in laboratories here.

Resource Technologies. A radar propagation project was a collaborative effort with the University of Essex and Atmospheric Environment Service (Canada), and also involved British Telecom and the European Space Agency. Links between feeder clouds and the development of large hailstones in severe thunderstorms were demonstrated in Alberta.

Terrain Sciences. The development of a protoype Land Related Information System (LRIS) for Bin County, Heilongjiang, China, was completed and is due for delivery in early 1990. Products include a series of maps and reports pertaining to soils and land use. A soil erosion application was developed to demonstrate use of geographic modelling and map analysis techniques.

Auditor's Report

To the Board of Directors of the Alberta Research Council

I have examined the balance sheet of the Alberta Research Council as at March 31, 1989 and the statement of revenue, expenditure and equity for the year then ended. My examination was made in accordance with generally accepted auditing standards, and accordingly included such tests and other procedures as I considered necessary in the circumstances.

In my opinion, these financial statements present fairly the financial position of the Council as at March 31, 1989 and the results of its operations and the changes in its financial position for the year then ended in accordance with the disclosed basis of accounting, considered appropriate in the circumstances, as described in Note 2 to the financial statements applied on a basis consistent with that of the preceding year.

Donald D. Salmon

FCA
Auditor General

Edmonton, Alberta
July 7, 1989

Balance Sheet

as at March 31, 1989 (thousands of dollars)

Assets	**1989**	**1988**
Current:		
Cash	$ 8,024	$ 9,576
Accounts receivable	4,134	5,081
Accrued income receivable	2,867	2,382
Prepaid expenses	350	167
Advances to joint research ventures	166	620
Current portion – deferred pension costs (Note 3)	73	57
	15,614	17,883
Non-current:		
Deferred pension costs (Note 3)	291	287
Investment in limited partnership (Note 4)	200	200
	491	487
Fixed:		
Equipment (Note 5)	52,351	48,442
	68,456	66,812
Trust Fund:		
Cash	144	74
	$68,600	$66,886

Liabilities and Equity	**1989**	**1988**
Current:		
Accounts payable	$ 3,130	$ 3,259
Unearned contract revenue	1,709	3,210
Promissory note payable (Note 4)	200	200
Obligation under capital lease (Note 6)	–	549
	5,039	7,218
Non-current:		
Unearned contract revenue	–	568
Obligation under capital lease (Note 6)	–	544
	–	1,112
Equity:		
Fixed assets (Note 7)	52,351	47,349
Operating	4,384	3,740
Special purpose, Schedule 1	6,682	7,393
	63,417	58,482
	68,456	66,812
Trust Fund:		
Liability	144	74
	$68,600	$66,886

The accompanying notes are part of these financial statements.

Statement of Revenue, Expenditure and Equity

for the year ended March 31, 1989 (thousands of dollars)

	Operating	Special Purpose (Schedule 1)	Total 1989	Total 1988
Revenue:				
Grants from Province of Alberta:				
General Revenue Fund	$19,117	$ 4,383	$23,500	$25,547
Contract revenue:				
Provincial government departments and agencies	9,854	–	9,854	8,830
Other	11,041	525	11,566	9,210
	40,012	4,908	44,920	43,587
Expenditure:				
Manpower	24,587	1,064	25,651	23,641
Supplies and services	10,580	1,685	12,265	9,998
Fixed assets	4,273	923	5,196	4,618
Joint research ventures	–	1,875	1,875	1,823
	39,440	5,547	44,987	40,080
Excess (deficiency) of revenue over expenditure	572	(639)	(67)	3,507
Equity at beginning of year	3,740	7,393	11,133	7,626
	4,312	6,754	11,066	11,133
Transfer to operating equity	72	(72)	–	–
Equity at end of year	$ 4,384	$ 6,682	$11,066	$11,133

Notes to the Financial Statements

March 31, 1989

Note 1 ***Authority***

The Alberta Research Council operates under the authority of the Alberta Research Council Act, Chapter A-35.1, Statutes of Alberta 1981.

Note 2 ***Summary of Significant Accounting Policies and Reporting Practices***

(a) General

These financial statements have been prepared in accordance with generally accepted accounting principles except that purchases of fixed assets are charged to operations in the year of acquisition. Notwithstanding the above, fixed assets are shown on the balance sheet at original cost, or at estimated cost, with the offsetting credit to fixed assets equity.

(b) Advances to Joint Research Ventures

Advances to joint research ventures are recorded as assets of the Council. The asset is reduced and a corresponding charge is made to expenditure for the Council's share of joint research venture expenses.

(c) Patents

Expenditures for patents owned by the Council as a result of research activity are not capitalized due to the uncertain value of benefits which may accrue to the Council.

(d) Contract Revenue Recognition

Contract revenue is recognized as costs are incurred, up to the contract maximum and in accordance with contracted cost-sharing ratios. The Council makes full provision for all known or estimated losses on uncompleted contracts as soon as they can reasonably be estimated.

(e) Investment

The Council is a minority shareholder in International Permeation Inc. The equity allocated to the Council was based on the technological "know-how" acquired by International Permeation Inc. from a former company to which the Council provided research and technological expertise and was the majority shareholder.

The Council's equity in the company is not reflected in these financial statements due to the uncertain value of benefits which may accrue to the Council.

(f) Special Purpose Equity

Special purpose equity is to be used only for future expenditures related to those activities listed on Schedule 1.

(g) Trust Liability

Trust funds are contributions received from other government departments under research agency agreements which require the Council to administer the contributions and provide accounting services.

(h) Changes in Financial Position

A statement of changes in financial position is not provided as disclosure in these financial statements is considered to be adequate.

Note 3 ***Deferred Pension Costs***

Total past service pension costs are being amortized on a straight-line basis over six years.

Balance at beginning of year	$344,427
Add: Additions	108,093
	452,520
Less: Amortization	88,288
	364,232
Less: Current portion	72,846
Balance at end of year	$291,386

Note 4 ***Investment in Limited Partnership***

The Council has purchased one limited partnership unit in Spurt Investment Fund I, a venture capital fund designed solely to make equity investments in seed and early stage technology enterprises. The partnership unit which cost $300,000, was acquired with a payment of $100,000 and a non-interest-bearing promissory note requiring payments of $100,000 on each of October 27, 1986, and 1987. At the request of the partnership, the 1986 and 1987 payments were not made and are now payable upon demand. As it is uncertain if any benefits will accrue to the Council, the investment is being written off as payments are made. The amount of the investment is summarized as follows:

	1989	1988
Original cost	$300,000	$300,000
Less: Amount written off	100,000	100,000
Book value	$200,000	$200,000

Note 5 ***Fixed Assets***

Fixed assets purchased subsequent to April 1, 1981 are valued at cost. Those purchased prior to April 1, 1981 by the Council are at estimated cost.

Included in fixed assets, are certain fixed assets purchased as a result of research contracts which specify that the Council does not receive title to the fixed assets purchased until completion of the contract or at the discretion of the sponsor.

Fixed assets comprise:

	1989	1988
Owned by the Council	$49,721,063	$46,904,699
Held by the Council on behalf of other government agencies and third parties	2,312,810	1,199,658
Owned by the Council and held by joint venture parties	316,834	337,661
	$52,350,707	$48,442,018

Note 6 ***Obligation Under Capital Lease***

In 1987, the Council entered into a capital lease agreement for a computer system. During the year, the Council paid out this capital lease obligation of $1,093,027 and acquired the related equipment.

Note 7 ***Fixed Assets Equity***

	1989	1988
Balance at beginning of year	$47,348,991	$42,122,316
Add: Additions at cost	4,504,542	4,618,472
Reduction of obligation under capital lease	1,093,027	501,893
Physical count adjustment, net	–	1,306,817
	52,946,560	48,549,498
Less: Disposals at cost	595,853	1,200,507
Balance at end of year	$52,350,707	$47,348,991

Note 8 ***Contingent Liabilities***

Statements of claim have been filed against the Council for approximately $612,000 by former employees for wrongful dismissal. The outcome of these proceedings is not determinable at this time.

Note 9 ***Obligations Under Operating Leases***

Year ending March 31,	1990	$ 354,044
	1991	291,550
	1992	243,780
	1993	129,168
	1994	118,367
		$1,136,909

Note 10 ***Occupancy and Office Furniture Expenditure***

The premises occupied by the Council and some office furniture have been provided by the Province of Alberta at no cost and are not reflected in these financial statements.

Note 11 ***Approval of Financial Statements***

These financial statements were reviewed by management and recommended to the Board for approval.

Schedule of Special Purpose Revenue, Expenditure and Equity

for the year ended March 31, 1989 (thousands of dollars)

Schedule 1

	Electronics Test Centre	Office of Science & Technology	Joint Research Ventures Program	Mill Woods/ Devon Fitting Up	Electronics Industry Information Centre	Bio-technology Toll Facility	Total 1989	Total 1988
Revenue:								
Grants from Province of Alberta:								
General Revenue Fund	$ 900	$ –	$3,201	$ –	$ 282	$ –	$4,383	$7,997
Contract revenue	524	–	–	–	1	–	525	440
	1,424	–	3,201	–	283	–	4,908	8,437
Expenditure:								
Manpower	776	–	189	–	95	4	1,064	902
Supplies and services	517	–	–	20	117	1,031	1,685	1,270
Fixed assets	45	–	36	372	5	465	923	2,321
Joint research ventures	–	–	1,875	–	–	–	1,875	1,823
	1,338	–	2,100	392	217	1,500	5,547	6,316
Excess (deficiency) of revenue over expenditure	86	–	1,101	(392)	66	(1,500)	(639)	2,121
Balance at beginning of year	205	72	1,399	942	168	4,607	7,393	5,272
Transfer to operating equity	–	(72)	–	–	–	–	(72)	–
Balance at end of year	$ 291	$ –	$2,500	$ 550	$ 234	$3,107	$6,682	$7,393

People – Outstanding Contributions

The Alberta Research Council's reputation, at home and abroad, rests with its employees. The men and women who carry out research and testing, and the staff who support them, share equally in the corporation's achievements.

An awards dinner is held annually to recognize the outstanding achievements made by staff during the year. This year, a new category was added – the Past Presidents' Award of Excellence – honoring contributions by all Alberta Research Council presidents, and presented for 'recognizable excellence' in an outstanding contribution, achievement, service, or activity.

Past Presidents' Award of Excellence:

Dr. Terry W. Stone (Professional)
Jim Kinasewich (Technical)
Bob Zezulka (Technical)
Sheila Binda (Support)

Patents:

Dr. Lars Bach: U.S. Patent, "Transverse Vibration Apparatus for Grading Wood Panels"
Dr. C.Y. Pan and Earl M. Hadfield: U.S. Patent, "Permeation Process for Separating Ammonia from a Gas Mixture"

Best Paper:

Brian A. Rottenfusser [N.K. Alwast, J.E. Palfreyman]: "The AOSTRA Underground Test Facility - Concept and Geological Setting"

External Professional Award:

Terry M. Macyk: The Dr. E.M. Watkin Award at the 13th Annual Conference of the Canadian Land Reclamation Association, in recognition of major contributions in research and/or field applications in land reclamation

Long-term Service (25 years):

Len M. Chase

Senior Level Promotions:

Dr. Bryan J. Fuhr to Senior Research Officer
Dr. Baki Ozum to Senior Research Officer
Mark R. Johnson to Senior Research Officer
Garry C. Cardinal to Research Technologist IV
Ross Chow to Research Technologist IV
Robert L. Silliphant to Research Technologist IV

Safety:

Ed G. Fitzpatrick
Nisku Site Emergency Response Team

Team Effort:

Alberta Geological Survey: Alberta Geological Survey technical display on core from the Cretaceous sand deposits of the Athabasca, Peace River, and Cold Lake areas, and the Devonian carbonate core from the Grosmont Formation, exhibited at the 4th International Conference on Heavy Crude and Tar Sands.

Sheila Binda, secretary for the Alberta Geological Survey, is the first recipient of the Past Presidents' Award of Excellence in the support category. She is seen here receiving the award and congratulations from Dr. Clem Bowman, president.

Information Services

The Alberta Research Council maintains three information centres and the Alberta Waste Materials Exchange (see page 32) for the benefit of industry, government, the general public, and staff. In addition, a Technology Line was installed in December to augment the Research Council's business development and marketing activities. The 1-800-661-2000 number operates toll free in Alberta, offering rural and urban businesses equal access to the corporation's research and testing services.

Industrial Information: with outlets in both Edmonton and Calgary, provides industry with access to most of the world's published scientific and technical literature.

Information Geology: manages GEODIAL, the provincial database, and contributes geological information to GEOSCAN, the national database.

AOSTRA Library and Information Services (ALIS): funded by AOSTRA and managed by the Alberta Research Council, ALIS is the central source for all published information on oil sands, heavy oil, and selected publications on enhanced recovery processes.

Publications: Published technical reports, maps, and other Alberta Research Council brochures and reports are available for sale from the Publications offices in Edmonton and Calgary.

Cathy Sampson answers the Technology Line, the Alberta Research Council's 1-800 number, offering equal access to its research and testing services for rural and urban communities throughout Alberta.

Patents and Publications

Patents

Alkali recycling process for recovery of heavy oils and bitumens. Canada 1129601, USA 4409091
Kessick, M.A.

Apparatus for progressively removing layers of overburden from an inclined side of a cut. Canada 1064059, USA 4183586
Owen, H.D., and T. Smith

Apparatus for the manufacture of a corrugated waterboard panel. USA 4616991
Bach, L., and E. Stark

Arc welding. Canada 1090427, USA 4295031
Roen, R.A.

Article passing rotary seal. Canada 984862, USA 3907373
Jensen, E.J., and L.M. White

Beneficiation process for oxidized iron ore. Canada 1125030, USA 4246025
Bertram, E.F., and P. Harris

Coal liquefaction process with oil sand bitumen derived solvent. Canada 1160586
Moschopedis, S.E.

Combination solvent injection-electric current application method for establishing fluid communication through heavy oil formation. Canada 1166151, USA 4450909
Sacuta, A.

Desulfurization of fluid coke. Canada 1098464
George, Z.M.

Enhanced oil recovery using electrical means. Canada 1099210, USA 4228854
Sacuta, A.

Formation of coke from heavy crude oils in the presence of calcium carbonate. Canada 1156952, USA 4521382
Kessick, M.A., Z.M. George, and L.G. Schneider

Hydrodesulfurization of coke. Canada 1125686, USA 4529501
George, Z.M.

In situ formation of oil-in-water emulsion from bituminous oil deposits. Canada 1136542
Kessick, M.A., C.E. St. Denis, and D.J. Currie

Lime addition to heavy crude oils prior to coking. Canada 1156953, USA 4521383
Kessick, M.A., Z.M. George, and L.G. Schneider

Method of feeding ruminants N-Glucosyl-N'-Hydroxymethyl-urea. USA 3843799
Elofson, R.M., L.P. Milligan, J. Wohlebe, and M. Worsley

Method of preparation of coal for safe transport and storage. Canada 959783
Berkowitz, N., and J.G. Speight

Method of transporting a substance along a pipeline. Canada 881986, USA 3633976
Kruyer, J.

Method of transporting oil and natural gas along a pipeline. Canada 973775, USA 3906972
Jensen, E.J., R.A.S. Brown, and E.J. Wiggins

Pipeline transportation of suspensions of subdivided solids. Canada 702627
Berkowitz, N., and C. Moreland

Pipeline transportation of heavy crude oil. Canada 1137005, USA 4343323
Kessick, M.A., and C.E. St. Denis

Process for the manufacture of a corrugated waterboard panel. USA 4675138
Bach, L., and E. Stark

Process for recovering bitumen from tar sand. Canada 1085760, USA 4236995
Kruyer, J.

Process for the preparation of trans-3-formyl-but-2-enenitrile. Canada 1172644, USA 4374069
Chen, S.C., and J.M. MacTaggart

Production of metallurgical coke from oxidized coking coal. Canada 1111366, USA 4259083
Ignasiak, B.

Regeneration process for poisoned Claus alumina catalyst. Canada 1097317, USA 4183823
George, Z.M.

Regeneration process for poisoned Claus alumina catalyst, including NaOH activation. Canada 1184169, USA 4469803
George, Z.M.

Ruminant feed supplement and process for producing same. Canada 1037768, USA 4044156
Diner, U., and R.M. Elofson

Seedling container. Canada 939905, USA 3786003
Creighton, S.M., D.L. Mitchell, and W.C. Kay

Static bending apparatus for grading wood panels. Canada 1222884, USA 4675138
Bach, L., and A.W. Porter

Transition metal catalyst. Canada 1094532, USA 4142993
Gadallah, F., and R.M. Elofson

Transverse vibration apparatus for grading wood panels. Canada 1264019, USA 4722223
Bach, L., and A.W. Porter

Treatment of oil sands slimes and modified bitumen recovery process. Canada 1138361
Kessick, M.A.

Bulletins

57 *Andriashek, L.D., and M.M. Fenton.* 1989. **Quaternary stratigraphy and surficial geology of the Sand River area 73L.** $30.00

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59 *Hitchon, B., S. Bachu, C.M. Sauveplane, A. Ing, A.T. Lytviak, and J.R. Underschultz.* 1989. **Hydrogeological and geothermal regimes in the Phanerozoic succession, Cold Lake area, Alberta and Saskatchewan.** $15.00

60 *Bachu, S., E.H. Perkins, B. Hitchon, A.T. Lytviak, and J.R. Underschultz.* 1989. **Evaluation of effects of deep waste injection in the Cold Lake area, Alberta.** $15.00

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Workshop, 11-15 September 1989. Edmonton, Alberta. 5 pp.

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1741 *Nunan, J.G., C.E. Bogdan, K. Klier, K.J. Smith, C.W. Young, and R.G. Herman.* 1988. **Methanol and C_2 oxygenate synthesis over cesium doped Cu/ZnO and Cu/ZnO/Al_2O_3 catalysts: A study of selectivity and ^{13}C incorporation patterns.** Journal of Catalysis 113: 410-433.

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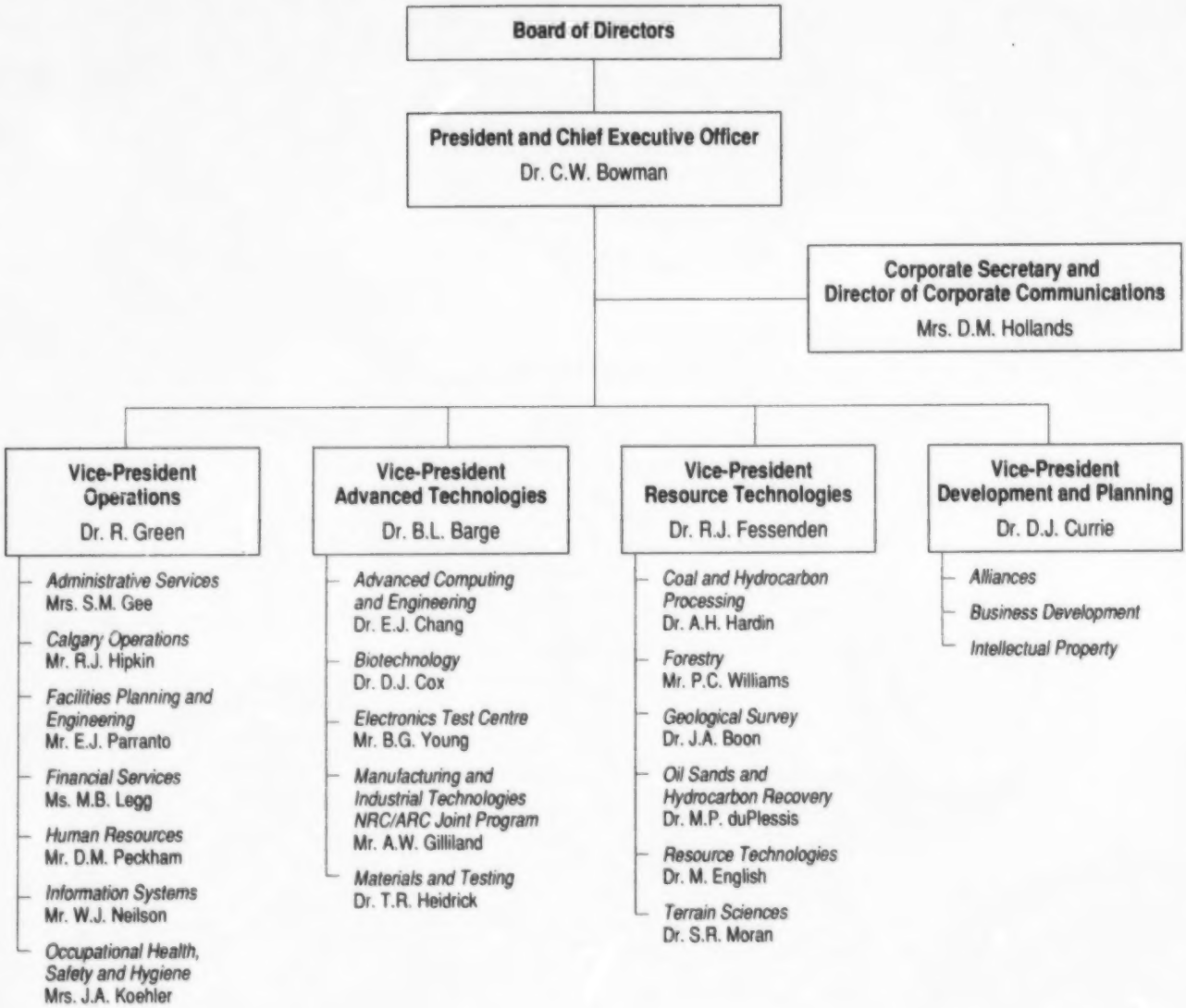

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Dr. Bayrock completed his doctoral thesis in glacial geology at the University of Wisconsin, and became a premier mapper and expert on the surficial deposits of Alberta. He joined the Alberta Research Council in 1957 and during his 15 years with the Research Council he developed mapping procedures best suited to the terrain of the western plains and mapped more than 250,000 square kilometres of terrain. Dr. Bayrock was author or co-author of more than 70 published articles. For the past 17 years, he lived in Vancouver where he was a geological consultant.

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